International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN (P): 2249-6890; ISSN (E): 2249-8001
Vol. 8, Issue 4, Aug 2018, 933-942

PARAMETRIC OPTIMIZATION IN MICRO- DRILLING BY APPLYING FUZZY LOGIC FOR ALUMINIUM PLATE

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ABSTRACT

Fuzzy logic systems square measure wide is used for management, system identification, and pattern recognition issues. It achieves the deduction in improvement that describes the dynamic behaviour of the system to be controlled. Thanks to the quantity, complexness and unclear, imprecise nature of the variables of the dynamic systems which will influence the call the choice maker's decision, symbolic logic is that the most fitted answer. Most of automotive parts square measure factory-made employing a standard machining method, like turning, drilling, milling, shaping and designing, etc. Out of that standard method of Drilling originates hole on any metal. Micro Drilling is high exactitude method for smaller holes below 1mm. It is used for the aim increasing quality of special components and things throughout the goal in machining operations. This analysis aims to analyze the result of the cutting speed, feed rate and depth of the hole on Material Removal Rate (MRR) and Machining time in a small drilling were analyzed. Experiments were conducted supporting the Taguchi style of experiments (DOE) with orthogonal array, with improvement of the Fuzzy constant quantity deduction to Optimize MRR.

KEYWORDS: Micro-Drilling, Cutting Tool, Material Removal Rate, Fuzzy Logic & Taguchi

Received: Jun 10, 2018; **Accepted**: Jul 06, 2018; **Published**: Aug 03, 2018; **Paper Id**.: IJMPERDAUG201897

Original Article

INTRODUCTION

Fuzzy sets are the sets whose components have degrees of membership. Fuzzy sets were introduced by Lotfi A. Zadeh associate degreed Dieter Klaua in 1965 as an extension of the classical notion of set. At constant time, outlined additional general quite structures known as L-relations that were studied by him in associate degree abstract pure mathematics context. Fuzzy relations, that are used currently in several areas, like linguistics decision-making (Kuzmin, 1982) and bunch, are special cases of L-relations once L is the unit interval [0, 1]. System performance may be improved by enterprise style optimisation method in fuzzy system during which the adjustable parameters are tuned to maximise a given performance criterion some and are tuned to reduce. Fuzzy linguistic models allow the interpretation of verbal expressions into numerical ones. Therefore, the input and output relationship of the method is represented by the gathering of fuzzy management rules involving linguistic variables instead of an advanced dynamic mathematical model [1]. Material removal rate is usually thought-about as a serious producing goal in machining operations in several of the prevailing analysis. Taguchi methodology, associate degree experiment style methodology, has been widely applied to several industries. It cannot solely optimize quality characteristics through the setting of style parameters, however additionally cut back of the

sensitivity of the system performance to the sources of variation. [2]

Micro-drilling refers to the drilling of holes but with zero.5 mm (0.020 in). Drilling of holes at this little diameter presents bigger issues since agent fed drills cannot be used and high spindle speeds are needed. High spindle speeds that exceed ten, 000 revolutions per minute additionally need the utilization of balanced tool holders. Small drilling is one among the foremost basic machines technologies and its moving high exactitude and high spindle speed application in producing field and increasing productivity and quality. Currently a day's small drillings have a good use for producing to use special elements and things. Small hole drilling is that the exactitude hole drilling technology to use in the producing and work search. The small drill tools play a crucial role is increasing the productivity of a cutting method. Though the value of a cutter itself is comparatively low, the prices caused by tool failures are significantly higher. Therefore, from the point of view of value and productivity, modelling and optimisation of drilling processes are very necessary for the producing trade. The poor removal of chips in deep drilling of little diameter is usually the reason behind tool breakage and poor quality surface. In the high speed machining technology, the smaller the tools, the upper the spindle speed ought to be expeditiously machine quality elements and avoid tool breakage. High-frequency spindles with speed ranges.[3] Cutting tools are used largely of the fabric Tugnsten Carbide which are obtainable in the wide selection of micro millimetre sizes, longer flute length, improves the resistance longer life of the tool, higher chip evacuation, and lowers the friction throughout drilling method and permits deeper drilling.

PERFORMANCE OF EXPERIMENT

An Experiment was applied on a CNC small drilling processes (figure no.1) so as to search out the simplest quality of drilling of Brass material. Drilling bit size was zero, 0.3mm and 0.5mm. Experiments were performed with a totally different high spindle speed (12,000-24,000 rpm) and feed at 3 different levels. The results were analyzed victimisation optimisation of method parameters, MRR. [3] So as to with efficiency scale back the standard experimental tasks, the orthogonal array by victimisation style parameters are planned and adopted [4]. Victimisation Mini tab seventeen of Taguchi style Experiment considering 3 input parameters and 3 level orthogonal arrays are built as given below in the table no (1)

Taguchi Orthogonal Array style, L9 (3^3), Factors: three, Runs: 9, Columns of L9 (3^4)

Array, 1 two three and individual Machining time and Material Removal Rate was calculated by the victimisation below formula in equation no. (1) and (2) with their Signal to noise quantitative relation, and Signal to Noise quantitative relation is calculated as mentioned in equation no. (3) and (4).

Machining time = DOH/Speed /Feed (1)

MRR = Initial weight-Final weight/ density/machining time (2)

S/N=-10 (log sum y2/n) Lower the better (3)

S/N=-10 (log sum (1/ y2)/n) higher the better (4)

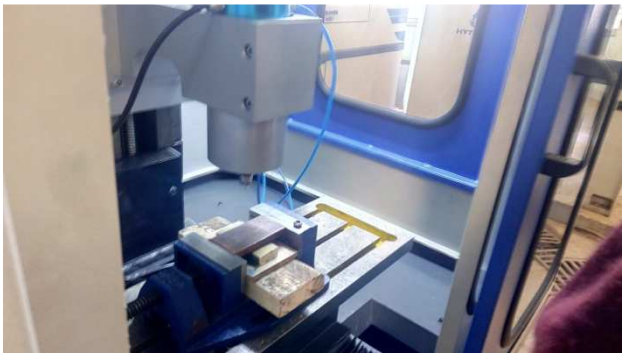

Figure 1: Micro-Drilling Machine

Table 1

Drill Dia	Speed	Feed	DOH	MT	MRR	SNRA1	SNRA2
0.3mm	12000	0.001	3	0.25	0.8478	12.0412	-1.43413
	12000	0.0015	4	0.222222	1.2717	13.06425	2.087693
	12000	0.002	5	0.208333	1.6956	13.62482	4.586468
	18000	0.001	4	0.222222	1.2717	13.06425	2.087693
	18000	0.0015	5	0.185185	1.90755	14.64788	5.609519
	18000	0.002	3	0.083333	2.5434	21.58362	8.108293
	24000	0.001	5	0.208333	1.6956	13.62482	4.586468
	24000	0.0015	3	0.083333	2.5434	21.58362	8.108293
	24000	0.002	4	0.083333	3.3912	21.58362	10.60707
0.5mm	12000	0.001	3	0.25	2.355	12.0412	7.439818
	12000	0.0015	4	0.222222	3.5325	13.06425	10.96164
	12000	0.002	5	0.208333	4.71	13.62482	13.46042
	18000	0.001	4	0.222222	3.5325	13.06425	10.96164
	18000	0.0015	5	0.185185	5.29875	14.64788	14.48347
	18000	0.002	3	0.083333	7.065	21.58362	16.98224
	24000	0.001	5	0.208333	4.71	13.62482	13.46042
	24000	0.0015	3	0.083333	7.065	21.58362	16.98224
	24000	0.002	4	0.083333	9.42	21.58362	19.48102

The performance live, S/N ratio (S/N) will get the best parameter mixtures. Within the Taguchi methodology, a loss perform are going to be outlined to calculate the deviation between the experimental price and also the desired price. Usually, the area unit 3 classes of the performance characteristics within the analysis of the signal-to- noise quantitative relation, i. e., the better. To obtain the best machining performance, the minimum Machining time and also the most MRR area unit desired. Therefore, the lower the-better MT and also the higher-the higher MRR ought to be elect. This methodology, the S/N quantitative relation is employed to work out the deviation of the performance characteristic from the required price. The S/N quantitative relation is found by mistreatment Taguchi Analysis in Minitab 17[6]

Taguchi Analysis: MRR versus Speed, Feed, DOH

FUZZY LOGIC

MATLAB could be a convenient software system to perform formal logic methodology. Considering Signal to noise ratios for MRR and MT among the intervals of thirty four to forty six and fifty seven to seventy two severally as

input variables and to urge OPI i. e.

Optimal performance Index kind zero to one interval [7] it's dispensed by process the Input /Output variables Figure no 2 a & b then the Member functions were elect for zero.3mm and 0.5mm. Figure no.3 a, b, c and d. Then fuzzy rules were developed as shown in Table no 2. Then centre of mass for every combination of SNR was found as a price of best Performance Index(OPI), that is named Defuzzification. Shown in figure 4 a, b, c and d and price of OPI is given in Table no.3

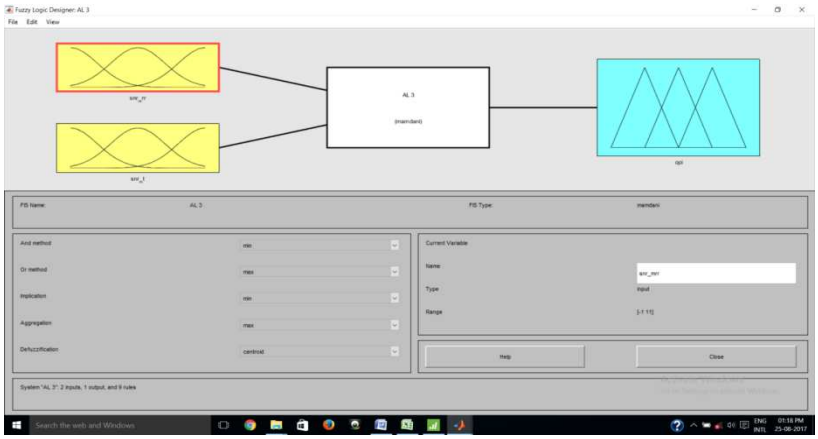

Figure 2 (a): Defining Input Output Variables for Drill Dia 0.3 mm

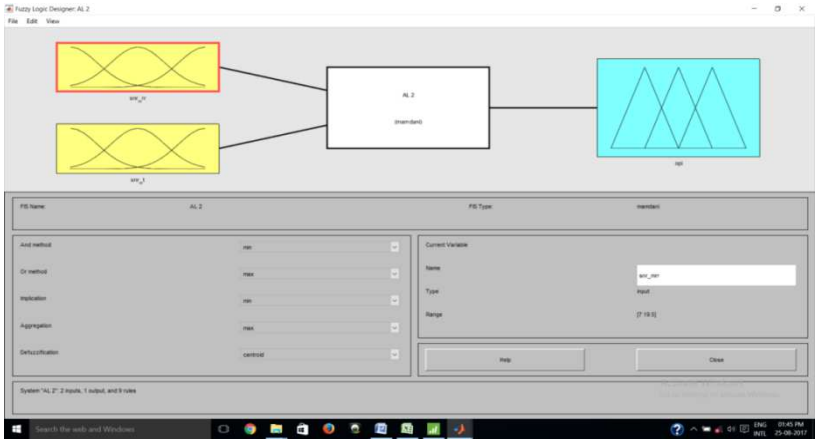

Figure 2 (b): Defining Input Output Variables for Drill Dia 0.5 mm

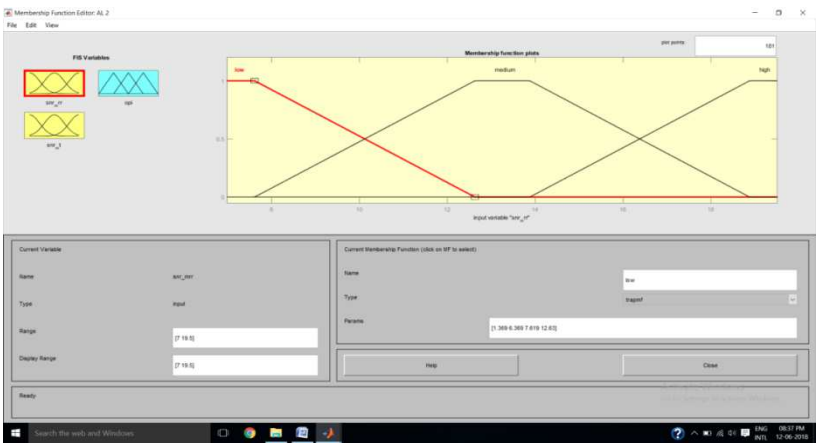

Figure 3 (a): Membership Function for Input Variables for Drill Dia 0.3mm

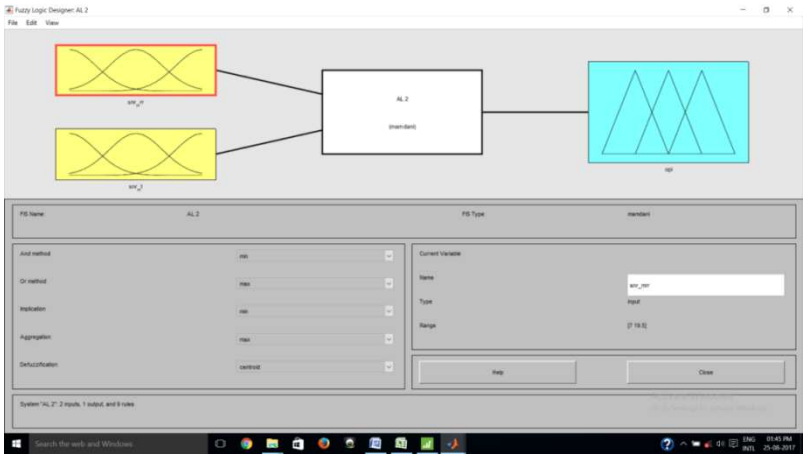

Figure 3 (b): Membership Function for Input Variables for Drill Dia 0.5m

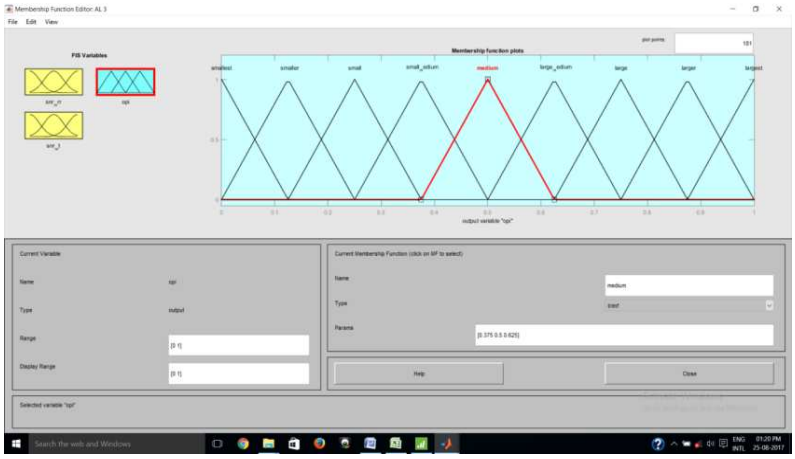

Figure 3 (c): Membership Function for Output Variables for Drill Dia 0.3mm

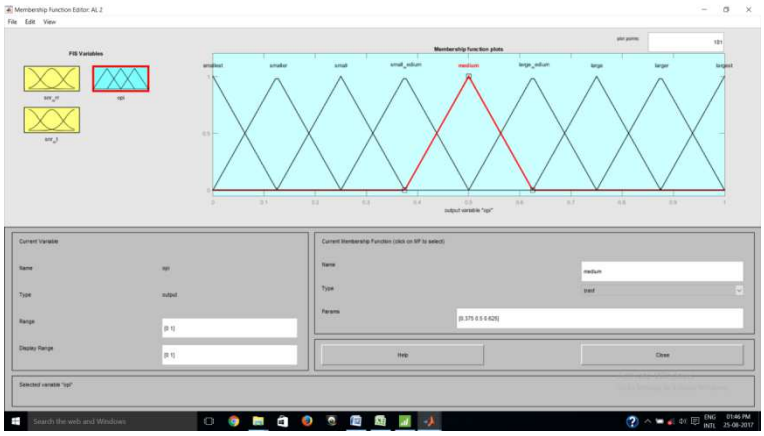

Figure 3 (d): Membership Function for Output Variables for Drill Dia 0.5mm

Table 2

Sr. No	SNR MRR	SNR MT	OPI
1	Low	Low	Small
2	Low	Medium	Smaller
3	Low	High	Smallest
4	Medium	Low	Larger
5	Medium	Medium	Largest

Table 2: Contd.,

6	Medium	High	Large
7	High	Low	Small Medium
8	High	Medium	Large Medium
9	High	High	Medium

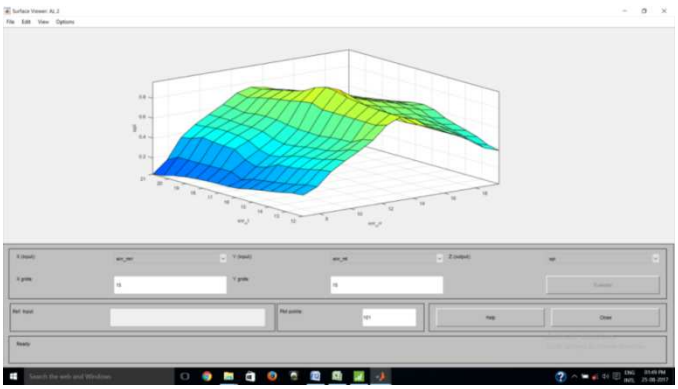

Figure 4 (a): Surface Plot for 0.3mm Dia

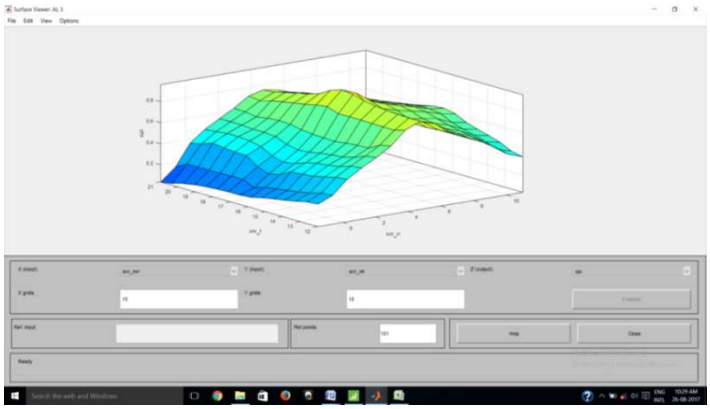

Figure 4 (b): Surface Plot for 0.5mm Dia

Figure 4 (c): Defuzzification for 0.3 dia

Figure 4 (d): Defuzzification for 0.5 dia

Table 3

	Input Value		Ouput Value
Drill dia	**SNRA1**	**SNRA2**	**OPI**
0.3mm	12.0412	-1.43413	0.25
	13.06425	2.087693	0.552
	13.62482	4.586468	0.878
	13.06425	2.087693	0.552
	14.64788	5.609519	0.832
	21.58362	8.108293	0.618
	13.62482	4.586468	0.883
	21.58362	8.108293	0.0618
	21.58362	10.60707	0.5
0.5mm	12.0412	7.439818	0.25
	13.06425	10.96164	0.581
	13.62482	13.46042	0.883
	13.06425	10.96164	0.581
	14.64788	14.48347	0.761
	21.58362	16.98224	0.605
	13.62482	13.46042	0.883
	21.58362	16.98224	0.761
	21.58362	19.48102	0.5

RESULTS

By considering the parameter mixtures of the 9 sets of experiment supported by the L9 orthogonal array, the quantified results from fuzzy deduction for the MRR square measure determined within the type best Performance Index and shown in the Table 4. Introducing the deduction results because the Mean for MRR underneath larger-the-best expectation, the results of issue responses square measure calculated and listed in Table five. The mean effects for suggests that square measure then drawn by MINITAB seventeen and shown in the Figure No. 5 and 6 for 0.3mm and 0.5mm diameter respectively.

Results of OPI square measure recorded and response table for analysis of mean is finished in TAGUCHI Analysis Taguchi Analysis: OPI one versus Speed, Feed, DOH

Table 4

Response Table for Means 0.3				Response Table for Means 0.5			
Level	**Speed**	**Feed**	**DOH**	**Level**	**Speed**	**Feed**	**DOH**
1	0.5527	0.5527	0.4973	1	0.5713	0.5713	0.5387
2	0.6783	0.6680	0.5167	2	0.6490	0.7010	0.5540
3	0.6680	0.6783	0.8850	3	0.7147	0.6627	0.8423
Delta	0.1257	0.1257	0.3877	Delta	0.1433	0.129	0.3037
Rank	2.5	2.5	1	Rank	2	3	1

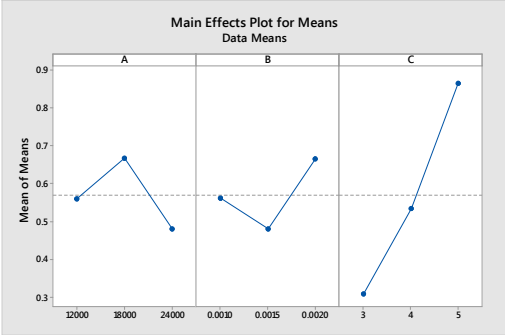

Figure 5: Mean for Drill Dia 0.3 mm

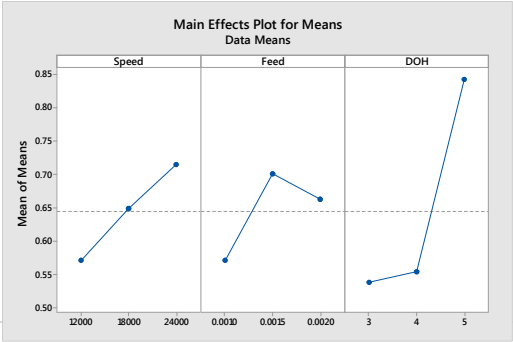

Figure 6: Mean for Drill Dia 0.5mm

CONFIRMATION TEST

The optimum results achieved by our proposing deduction improvement technique, the machining operations beneath each fuzzy TAGUCHI optimization parameters and benchmark parameters; Speed (medium), Feed (medium), ut (medium), which area unit usually introduced into the confirmation experiment in several of the studies for comparison to the optimum parameters, area unit performed on the CNC Micro-drilling. It is determined that the MRR beneath fuzzy deduction parameters meets the benchmark parameter that is slightly quite benchmark parameters.

Table 5

Drill Dia	Benchmark	level	Fuzzy	Level
0.3 mm	18000	A2	24000	A3
	0.0015	B2	0.0015	B2
	4	C2	4	C2
MRR	1.9		2.54	
0.5mm	18000	A2	18000	A2
	0.0015	B2	0.002	B3
	4	C2	4	C2
MRR	5.30		7	

CONCLUSIONS

This constant quantity deduction theme was projected parameters below the concerns of MRR. Optimum deduction parameters was calculated to point the effectiveness of the projected fuzzy TAGUCHI optimisation methodology that was understood by confirmation check, additionally by this experimental results validate the efficiency that the MRR meets the benchmark parameters obtained from average worth of parameters this sort optimisation can counsel the makers to travel mathematical logic analysis through TAGUCHI before producing. This provides economically excitement to producing trade through the projected development during this study.

ACKNOWLEDGEMENT

The authors would really like to be precise to the specific sincere thanks to Sant Gadge Baba, Amravati University for registration of this analysis work and conjointly express thanks to the faculty of Engineering and Technology, Akola for availing necessary laboratories facilities. The authors conjointly appreciatively acknowledge the necessary funding of state faculty of Engineering, Jalgaon and conjointly grateful to Jawaharlal Darda Institute of Engineering and Technology, Yavatmal for his or her time to time facilitate the experiment.

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